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NATIONAL DAM SAFETY PROGRAM. PORTER RESERVOIR DAM (DE 00013) DE--ETC(U)
DEC 79 J J WILLIAMS DACW61-78-C-0052

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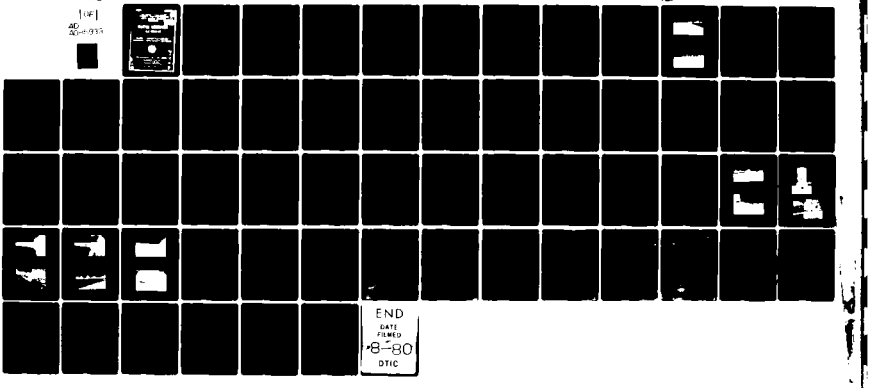

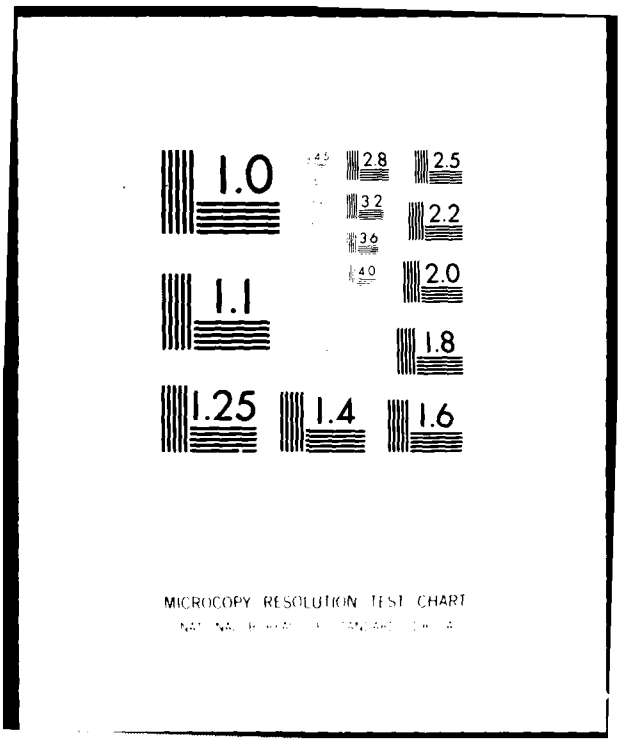
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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

6 JUN 1980

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Porter Reservoir in New Castle County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Porter Reservoir, a high hazard potential structure, is judged to be in good overall condition. The reservoir is capable of storing the selected design storm of one half of the Probable Maximum Precipitation. To ensure adequacy of the structure, the following remedial actions should be initiated within six months from the date of approval of this report:

a. Vegetation growing on the interior slope should be removed.

b. After the vegetation is removed, all gaps and spaces in the interior slope protection should be sealed.

c. The outlet tower access bridge should be repaired.

d. The existing maintenance program should be expanded to include regular inspection and repair of the interior slope protection. The portions of the interior slope below the reservoir level should be inspected and repaired during the periods of reservoir drawdown.

e. A six-inch diameter water main (wash-out main) shown on Figure 2, used to wash down the interior slope of the reservoir during periods of drawdown, is presently maintained under pressure. When not in use, the main should be depressurized to prevent damage to the embankment.

f. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

g. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

A copy of the report is being furnished to Mr. John E. Wilson III, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies Furnished:
Mr. John E. Wilson III, Acting Secretary
Department of Natural Resources and
Environmental Control
Edward Tatnall Bldg.
Dover, DE 19901

Mr. William R. Ratledge, Director
Division of Soil & Water Conservation
DDNR & EC
Dover, DE 19901

PORTER RESERVOIR (DE00013)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 20 September and 7 October 1979 by O'Brien & Gere Engineers, Inc., under contract to the U.S. Army Engineer District, Philadelphia in accordance with the National Dam Inspection Act, Public Law 92-367.

Porter Reservoir, a high hazard potential structure, is judged to be in good overall condition. The reservoir is capable of storing the selected design storm of one half of the Probable Maximum Precipitation. To ensure adequacy of the structure, the following remedial actions should be initiated within six months from the date of approval of this report:

a. Vegetation growing on the interior slope should be removed.

b. After the vegetation is removed, all gaps and spaces in the interior slope protection should be sealed.

c. The outlet tower access bridge should be repaired.

d. The existing maintenance program should be expanded to include regular inspection and repair of the interior slope protection. The portions of the interior slope below the reservoir level should be inspected and repaired during the periods of reservoir drawdown.

e. A six-inch diameter water main (wash-out main) shown on Figure 2, used to wash down the interior slope of the reservoir during periods of drawdown, is presently maintained under pressure. When not in use, the main should be depressurized to prevent damage to the embankment.

f. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

g. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 4 Jun 1980

DELAWARE RIVER BASIN

Name of Dam: Porter Reservoir Dam
County & State: New Castle County, Delaware
Inventory Number: DE 00013

(9) Final Rept.,

(10) Dam, Reservoir

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM.

(6) Porter Reservoir Dam (DE 00013)
Delaware River Basin, Matson Run
& Stream, New Castle County,
Delaware.
Final Inspection Report.

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

(11) Dec '78

(13) DACW61-78-C-0052 For (12) 60

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House-2nd & Chestnut Streets
Philadelphia, PA 19106

41075

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and anlayses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data availabe to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Porter Reservoir Dam	ID # DE 00013
State Located:	Delaware	
County Located:	New Castle	
Stream:	Offstream Matson Run	
Coordinates:	Latitude 39° 46.4', Longitude 75° 32.6'	
Dates of Inspection:	September 20, 1979 and October 7, 1979	

ASSESSMENT

Based on visual observations made on the dates of inspection, information provided by the Delaware Department of Natural Resources and Environmental Control (DNREC), the City of Wilmington, and conversations with the owner's representatives, Porter Reservoir Dam (owned by the City of Wilmington) is considered to be in overall good condition.

Porter Reservoir is an offstream impoundment located approximately 1,500 feet west of Matson Run, immediately east of U.S. Route 202 and 2,500 feet north of the corporate boundary of the City of Wilmington, Delaware. The dam is a homogeneous earth embankment aligned in a triangular configuration in plan view so that the dam completely encloses the reservoir. The embankment is approximately 2,100 feet long with a maximum height of about 22 feet. The interior slope of the embankment is lined with concrete and grouted paving blocks. The reservoir functions as a storage and settling basin for a portion of the water supply for the City of Wilmington.

The selected design storm for this Small size, High hazard dam is 50 percent of the Probable Maximum Precipitation (PMP). The reservoir is capable of retaining the entire design storm without overtopping of the embankment when the reservoir is maintained at or below the normal pool level indicated on Figure 2. Therefore, the spillway, which is a concrete box inlet with a maximum discharge capacity of 17.5 cfs, is classified as "Adequate."

Recommendations and remedial measures which should be initiated in the near future are as follows:

a. Facilities

1. Vegetation growing on the interior slope should be removed.

2. After the vegetation is removed, all gaps and spaces in the interior slope protection should be sealed.

3. The outlet tower access bridge should be repaired.

b. Operation and Maintenance Procedures

1. The existing maintenance program should be expanded to include regular inspection and repair to the interior slope protection. The portions of the interior slope below the reservoir level should be inspected and repaired during the periods of reservoir drawdown.

2. A six-inch diameter water main (wash-out main) shown on Figure 2, used to wash down the interior slope of the reservoir during periods of drawdown, is presently maintained under pressure. When not in use, the main should be depressurized to prevent damage to the embankment.

3. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

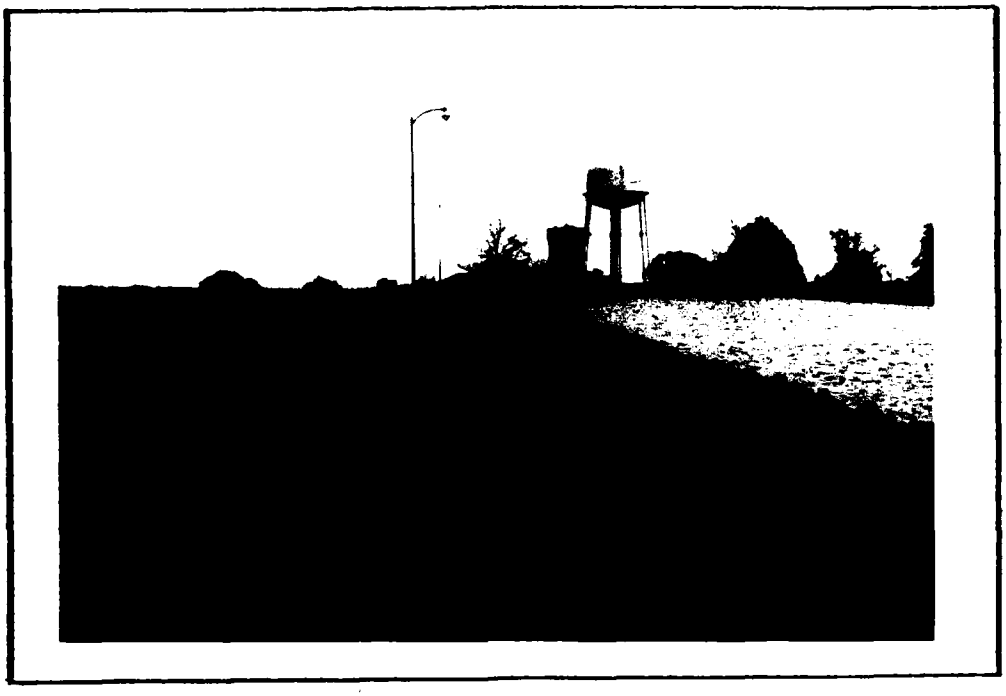
4. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

O'BRIEN & GERE ENGINEERS, INC.

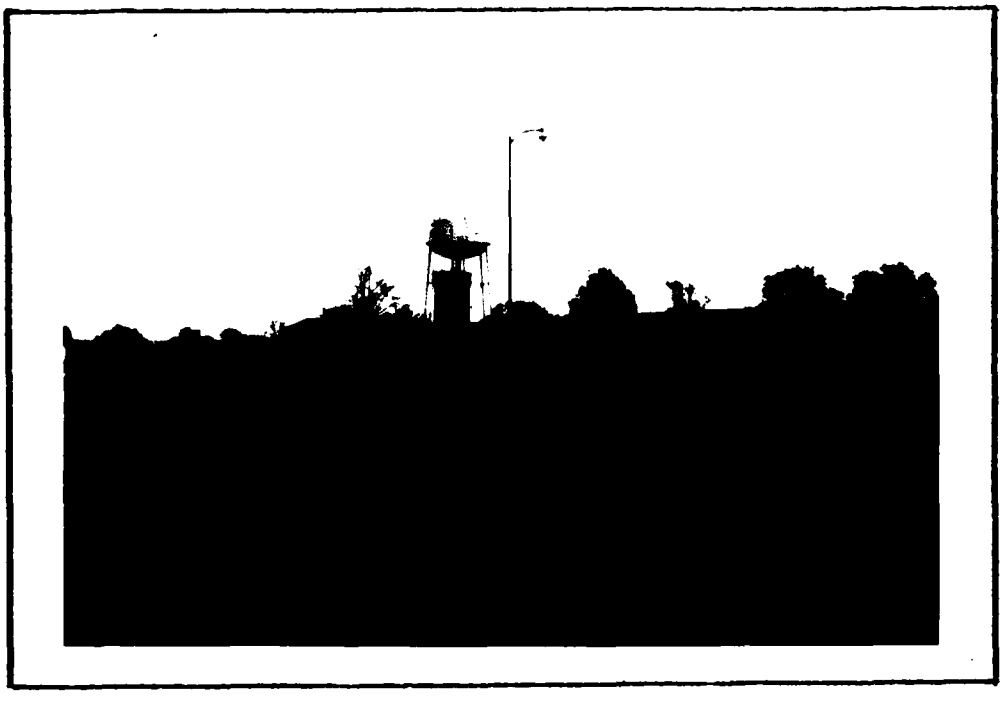
JOHN J. WILLIAMS REGISTERED PROFESSIONAL ENGINEER

John J. Williams, P.E.
Vice President
Delaware Registration No. 2884

Date: 8 FEB 1980



VIEW OF DAM AND RESERVIOR
FROM NORTHWESTERN CORNER OF DAM 9-20-79



VIEW OF EXTERIOR SLOPE
FROM NORTHWESTERN CORNER OF DAM 9-20-79

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(Continued)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
PORTER RESERVOIR DAM
INVENTORY NUMBER - DE 00013

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract # DACW 61-78-C-0052 between O'Brien & Gere Engineers and the United States Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection. The purpose of this inspection is to evaluate the structural and hydraulic condition of Porter Reservoir Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 Project Description (Based on information obtained from the Delaware Department of Natural Resources and Environmental Control (DNREC) Dover, Delaware, and the City of Wilmington, Delaware.)

a. Description of Dam and Appurtenances. Porter Reservoir Dam is a homogeneous earth embankment aligned in a triangular configuration in plan view so that the dam completely encloses the reservoir (refer to Figure 3 in Appendix E). The reservoir floor is excavated into the natural ground. The elevation of the toe of the interior slope varies from 0 to 12 feet below the toe of the exterior slope. The length of the perimeter of the embankment is approximately 2,100 feet and the maximum height is about 22 feet. The interior slope is 1.5H:1V and the exterior slope varies from 2H:1V to 5H:1V. The crest width of the dam is 15 feet. A stone masonry parapet extends three feet above the crest for the entire length of the dam.

The interior slope is protected by a 6-inch thick layer of concrete underlain by a 12-inch thick puddle layer from the toe to Elev. 277.0. From Elev. 277.0 to Elev. 286.7 and 8-inch thick layer of grouted paving blocks with a bed of gravel is provided over the layers of concrete and puddle. A concrete block extends the remaining 4 inches vertically to the top of the dam (Elev. 287.0). The exterior slope is protected by a 6-inch thick layer of sod. The floor of the reservoir is surfaced with a 6-inch thick layer of concrete underlain by a 12-inch thick puddle layer.

Water is supplied to Porter Reservoir by means of two pipes; a 42-inch diameter cast iron pipe located near the eastern corner of the reservoir and a 48-

inch diameter cast iron pipe located near the southwestern corner of the reservoir. The water is directed through the reservoir and toward the outlet tower by a series of baffle walls (see Figure 6 in Appendix E). The outlet tower houses 3 sluice gates with invert Elevations of 266.0, 272.0 and 277.0. The gates are 5 feet high and 3 feet wide. Outflow is directed into a 48-inch diameter distributing main which leads to the treatment plant. A 16-inch diameter sewer drain pipe is provided for draining the reservoir.

A 32-inch long, 15-inch wide box inlet spillway with a crest at Elev. 286.0 is attached to the wall of the outlet tower. The spillway is located directly beneath the outlet tower access bridge. Spillway flow is directed into a 24-inch diameter pipe which leads to the treatment plant.

b. Location. Porter Reservoir is an offstream impoundment located approximately 1,500 feet west of Matson Run immediately East of U.S. Route 202 and 2,500 feet North of the corporate boundary of Wilmington, Delaware. The reservoir is shown on the USGS Quadrangle entitled, "Wilmington North, Delaware-Pennsylvania" at coordinates N 39° 46.4', W 75° 32.6'. A regional location map of Porter Reservoir is included as Plate 1 in Appendix E.

c. Size Classification. Porter Reservoir Dam has a maximum height of about 22 feet and a maximum storage capacity of approximately 114 acre-feet. The dam is classified in the Small size category since it is less than 40 feet high with a storage capacity of less than 1,000 acre-feet.

d. Hazard Classification. There are several buildings and a golf course located between Porter Reservoir and Matson Run. Route 202 borders the dam on the west side. A failure of the embankment would cause floodwaters to be directed either toward Matson Run or onto the highway, resulting in extensive property damage and probable loss of life. Therefore, the dam is classified in the High hazard category.

e. Ownership. Porter Reservoir Dam is owned by the City of Wilmington, Department of Public Works, Water Division, 800 French Street, Wilmington, Delaware, 19801.

f. Purpose of Dam. The dam was constructed to impound a water supply reservoir for the City of Wilmington.

g. Design and Construction History. Construction of Porter Reservoir Dam began about 1905 and was completed by 1909. Operation of the reservoir commenced during 1909. The baffle walls were added in 1917. The drawings indicate that the dam was designed and constructed by the City of Wilmington. However, this could not be verified.

h. Normal Operations Procedures. According to the owner's representative, the reservoir level is controlled by pumping water into the reservoir from the 16 Street and Wills Pumping stations. The middle sluice gate (invert Elev. 272.0) is maintained in the open position for constant water supply to the treatment plant while the upper and lower sluice gates remain closed. The reservoir level fluctuates with the water demand but is maintained below Elev. 285.0

1.3 Pertinent Data (Based on information obtained from the Delaware Department of Natural Resources and Environmental Control (DNREC) Dover, Delaware, and the City of Wilmington, Delaware.)

a. Drainage Area. The drainage area to Porter Reservoir is identical to the maximum pool surface area. The drainage area is 6.3 acres.

b. Discharge at Dam Site (cfs)

The spillway capacity immediately prior to overtopping of the embankment is 17.5 cfs.

c. Elevation (feet above MSL).

Normal Pool	285.0
Spillway Crest	286.0
Top of Dam	287.0
Top of Parapet	290.0
Minimum Reservoir Floor	265.0
Maximum Reservoir Floor	268.0
Lower Sluice Gate Invert	266.0
Middle Sluice Gate Invert	272.0
Upper Sluice Gate Invert	277.0

d. Reservoir Length (feet).

Normal Pool	800
Maximum Pool	805

e. Storage (acre-feet).

Normal Pool	102
Maximum Pool	114

f. Reservoir Surface Area (acres).

Normal Pool	6.2
Maximum Pool	6.3

g. Dam.

Type	Earth
Length	2,100 feet
Height	22 feet
Crest Width	15 feet
Side Slopes	1.5H:1V (interior) 2H:1V - 5H:1V (exterior)
Zoning	None
Impervious Core	None
Cutoff	None
Grout Curtain	None

h. Spillway

Type	Concrete Box Inlet
Crest Length	5.2 feet
Crest Elevation	286.0
Gates	None

i. Outlet Works.

Type	Water supply, see Section 1.2.a.
Length	250 feet (to treatment plant)
Closure	3 sluice gates; invert Elevations 266.0, 272.0 and 277.0
Access	A concrete foot bridge extends from the top of the dam to the outlet tower.
Regulating Facilities	Hand wheels are located in the tower for control of the sluice gate.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The engineering data made available by the Delaware DNREC consisted of the following drawings:

1. Embankment Section (1905)
2. Plan view of Dam and Reservoir (1905)
3. Plan and Sections (1905)
4. Plan and Profile with Storage Capacities (1923)

The following additional drawings were provided by the City of Wilmington:

1. Intake and Water Tower
2. Weir Tower
3. Porter Reservoir Baffles (3 sheets)

b. Design Features. The principal design features for this structure are shown on the drawings in Appendix E and are described in Section 1.2.a of this report.

2.2 Construction

No information relative to the actual construction of the dam is available. However, the design drawings indicate that the embankment was constructed about 1905.

2.3 Operation

Water is supplied to the reservoir from two city pumping stations, and withdrawn to the treatment plant through a 48-inch diameter distributing main. The water flows into the outlet tower by means of a 3-foot by 5-foot opening with an invert Elevation of 272. The sluice gates for two similar openings with invert elevations of 266 and 277 are kept closed.

The reservoir is drawn down periodically for removal of the accumulated sediments.

2.4 Evaluation

a. Availability. The available information was provided by DNREC and the City of Wilmington.

b. Adequacy. The information made available by DNREC and the City of Wilmington, conversations with the owner's representatives and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Validity. There appears to be no reason to question the validity of the data obtained.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Field inspections of Porter Reservoir Dam took place on September 20, 1979 and October 7, 1979. At the time of the inspection, the reservoir water surface was approximately 3.5 feet below the crest of the dam. No underwater areas were inspected. the observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The appearance of the facility indicates that the embankment is well maintained. However, the outlet tower, the parapet, the interior slope protection, and the baffle walls appear to be marginally maintained.

b. Dam. The crest and exterior slope of the embankment appear to be in good condition. The embankment supports a well-maintained grass cover and there is no evidence of slope instability.

Numerous gaps and spaces are apparent in the joints between the paving blocks on the interior slope above the water surface. Vegetation was observed at these joints in several locations. Minor undulations were noted at several locations along the interior slope.

Two areas of standing water and soft ground were noted near the toe at the eastern side of the dam. However, the Owner's representative stated that these areas are dry for the major portion of the year. The water appeared to be a result of surface runoff rather than seepage through the embankment.

c. Appurtenant Structures. The outlet tower appears to be in satisfactory condition. The concrete in the access bridge to the tower is cracked in several locations and is in need of minor repairs. The box inlet spillway shows no signs of deterioration. The sluice gate hoists appear to be in operable condition.

The baffle walls in the reservoir are in dilapidated condition and are not functioning as designed. Sections of the concrete have deteriorated, leaving large gaps in the walls in the vicinity of the reservoir surface.

d. Reservoir Area. The concrete surfaces of the reservoir bottom and the lower portion of the interior slope were below the water surface at the time of the inspection; therefore, their condition could not be determined.

e. Downstream Channel. Discharge from the reservoir is either through the water supply system or through the sewer drain pipe. Matson Run, the nearest stream is approximately 1,500 feet to the east of Porter Reservoir Dam.

SECTION 4

OPERATIONAL FEATURES

4.1 Procedures

According to the owner's representative, water is supplied to Porter Reservoir by means of two pipes; a 42-inch diameter cast iron pipe located near the eastern corner of the reservoir, and a 48-inch diameter cast iron pipe located near the southeastern corner of the reservoir. Each pipe operates for approximately 12 hours per day, so that water is constantly pumped into Porter Reservoir to maintain the reservoir level. Discharge to the treatment plant occurs through one of three rectangular openings in the outlet tower, and then through a 48-inch diameter distributing main. The upper and lower openings in the outlet tower remain gated and the middle opening is maintained in the open position.

4.2 Maintenance of Dam

According to the owner's representative, the dam is maintained on a regular basis. The grass cover was being mowed during the inspection. The interior slope above the reservoir surface was in need of maintenance on the date of the inspection.

4.3 Maintenance of Operating Facilities

According to the owner's representative, the sluice gates in the outlet tower are not operated. The metal grates across the openings were replaced about 1970.

4.4 Description of Any Warning Systems in Effect

There are no official flood warning systems in effect at this site.

4.5 Evaluation of Operational Adequacy

The exposed portion of the interior slope should be inspected and maintained on a regular basis.

Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Porter Reservoir has a maximum pool surface area of about 6.3 acres, a maximum storage capacity of about 114 acre-feet and a drainage area equal to the maximum reservoir surface area. The spillway has a maximum discharge capacity of 17.5 cfs.

Emergency drawdown of the reservoir can be accomplished by discharging through the water supply system and simultaneously through the 16-inch diameter sewer drain pipe.

b. Experience Data. The owner's representative stated that the reservoir level is measured and recorded at the treatment plant approximately every 6 hours. Rainfall records are also maintained at the treatment plant. Based on previous drawdowns, the owner's representative stated that the reservoir can be drawn down in about 2 days (by discharging into the water supply system and the reservoir drain).

c. Visual Observations. On the date of the inspection, it appeared that the box inlet spillway could easily be blocked. However, the reservoir is capable of storing the design storm without spillway discharge.

d. Overtopping Potential. Porter Reservoir Dam is isolated from surface runoff. Therefore, a design storm was selected for analysis rather than a Spillway Design Flood. The recommended design storm for a Small size, High hazard dam ranges from 50 percent of the Probable Maximum Precipitation (PMP) to the full PMP. Due to the small reservoir capacity and wide flood area, the selected design storm was 50 percent of the PMP.

Neglecting spillway discharge capabilities, Porter Reservoir Dam can retain the entire design storm in surcharge storage without overtopping of the embankment. The initial reservoir level for analysis was assumed equal to the normal pool elevation of 285.0 from Figure 2. In addition to spillway discharge, reservoir level increases during heavy storms may be discharged through the water supply and drawdown systems.

e. Spillway Adequacy. The design storm will not cause overtopping of the embankment. Therefore, the spillway is considered adequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. There is no evidence of slope instability or excessive settlement of the embankment. The vegetation growing from the joints in the paving blocks indicates the potential presence of cracks in the concrete under the paving blocks. Further deterioration of the interior slope protection could lead to erosion of the embankment and excessive seepage through the embankment.

The visible portions of the concrete baffle walls have been severely eroded and are in poor structural condition. However, these walls do not affect the integrity of the embankment.

The outlet tower appears to be in satisfactory structural condition, although the access bridge is in need of minor repairs.

b. Design and Construction Data. Porter Reservoir Dam appears to have been constructed in general conformance with the available design drawings. The drawings do not indicate the composition of the embankment material.

c. Operating Records. Records of operation are maintained at the treatment plant.

d. Post Construction Changes. The baffle walls were constructed in 1917. There is no record of any other modifications subsequent to the completion of construction.

e. Seismic Stability. Porter Reservoir Dam is located in Seismic Zone 1 on the "Seismic Zone Map of Contiguous States." A dam located in Seismic Zone 1 is generally considered to be safe under expected earthquake loadings in this zone if it is stable for static loading conditions. Based on the field inspection, Porter Reservoir Dam appears to be stable for static conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Porter Reservoir Dam is in good condition.

The selected design storm for this dam is 50 percent of the PMP. The reservoir is capable of retaining the entire design storm without overtopping of the embankment. In addition, the box inlet spillway and the water supply system provide discharge capacity.

b. Adequacy of Information. The information provided by DNREC and the City of Wilmington, conversations with the Owner's representatives, and observations made during the field investigation provided adequate data for a Phase I Investigation.

c. Urgency. The remedial measures recommended in Section 7.2 should be implemented in the near future.

d. Necessity for Further Investigation. None required.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities

1. Vegetation growing on the interior slope should be removed.

2. After the vegetation is removed, all gaps and spaces in the interior slope protection should be sealed.

3. The outlet tower access bridge shoud be repaired.

b. Operation and Maintenance Procedures

1. The existing maintenance program should be expanded to include regular inspection and repair to the interior slope protection. The portions of the interior slope below the reservoir level should be inspected and repaired during the periods of reservoir drawdown.

2. A six-inch diameter water main (wash-out main) shown on Figure 2, used to wash down the interior slope of the reservoir during periods of drawdown, is presently maintained under pressure. When not in use, the main should be depressurized to prevent damage to the embankment.

3. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

4. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

APPENDIX

A

Check List Engineering Data

Design, Construction, Operation

Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Porter Reservoir Dam

ID # DE 00013

ITEM	REMARKS
AS-BUILT DRAWINGS	None Available
REGIONAL VICINITY MAP	Refer to Figure 1 in Appendix E.
CONSTRUCTION HISTORY	No construction information is available.
TYPICAL SECTIONS OF DAM	Refer to Figures 2 and 3 in Appendix E.
OUTLETS - PLAN	Refer to Figures 4 and 5 in Appendix E.
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	None Available
RAINFALL/RESERVOIR RECORDS	Records are maintained at the Treatment Plant.

ITEM	REMARKS
DESIGN REPORTS	None Available
GEOLOGY REPORTS	None Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None Available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None Available
POST-CONSTRUCTION SURVEYS OF DAM	None Available
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Baffle walls were constructed in the reservoir in 1917. Design drawings are included as Figures 5 and 6 in Appendix E.
HIGH POOL RECORDS	Pool Elevations are recorded every 6 hours. The records are maintained at the Treatment Plant.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	The sluice gates are not operated on a regular basis. There is a general maintenance program.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Refer to Figur 4 in Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	Refer to Figures 4 and 5 in Appendix E.
MISCELLANEOUS	Four design drawings were obtained from the Delaware DNREC and five additional design drawings were provided by the City of Wilmington.

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Porter Reservoir Dam County New Castle State Delaware National ID # DE 00013

Type of Dam Earth Hazard Category High

Date(s) Inspection Sept. 20, 1979 Weather Clear Temperature 70° F

Pool Elevation at Time of Inspection 283.5± M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Lee DeHeer Leonard Beck Robert Bowers

Robert Bowers Recorder

Remarks:

Mr. Krishna Patel, Delaware DNREC, Mr. Fran Menton, Treatment Plant Superintendent, Mr. John Hanley, Assistant Engineer for Wilmington Public Works, and Mr. Paul Henry, Wilmington Water Systems Manager, were also present during the inspection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems observed.	
RIPRAP FAILURES	Numerous gaps were noted in the joints of the interior slope protection, Trees and bushes were growing from the joints in several locations.	The trees and brush should be removed and all gaps and cracks should be sealed.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems observed.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None	
DRAINS	The 16-inch diameter sewer was not visible.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	The intake structure has been termed the outlet tower in the report since the water leaves the reservoir through this tower. The outlet tower appeared to be in good condition, despite some cracking and spalling of the masonry.	
OUTLET STRUCTURE	Outflow is directed from the outlet tower to the Treatment Plant by means of a 48-inch diameter distributing main. The outlet end of the main in the Treatment Plant was not inspected.	
OUTLET CHANNEL	There is no outlet channel.	
EMERGENCY GATE	The middle of three sluice gates is maintained in the open position for water supply. The sluice gates were submerged, but the gate operators in the outlet tower appeared to be in working condition.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The weir is formed by a concrete box inlet which appeared to be in good condition.	
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Spillway discharge flows into the outlet tower, then through a 24-inch diameter pipe to the Treatment Plant.	
BRIDGE AND PIERS	None	

APPENDIX

C

Hydrologic & Hydraulic Data

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
PORTER RESERVOIR DAM	1	DBC	10/29/79	

HYDROLOGY

THE DRAINAGE AREA TO THIS RESERVOIR IS EQUAL TO THE RESERVOIR SURFACE AREA FOR THIS SITE. THEREFORE, THE DESIGN STORM (½ PMP) IS APPLIED DIRECTLY TO THE RESERVOIR.

FROM HMR #33, THE 24 HOUR - 200 SQUARE MILE PMP INDEX RAINFALL IS 24 INCHES.

THIS INDEX RAINFALL IS REDUCED BY THE HOP BROOK ADJUSTMENT FACTOR* OF .8 (≤10 sq.mi.). THEREFORE, THE ADJUSTED INDEX RAINFALL IS 19.2 INCHES.

THE EXPECTED 48 HOUR PMP RAINFALL FOR A BASIN WITH LESS THAN 10 SQUARE MILES OF DRAINAGE AREA IS 1.32 TIMES THE INDEX RAINFALL (OR 27.3 INCHES).

THE DESIGN STORM IS ½ OF THE PMP, OR 13.65 INCHES. SINCE THE RESERVOIR IS PROVIDED WITH 2 FEET OF FREE-BOARD ABOVE NORMAL POOL, THE ENTIRE DESIGN STORM CAN BE STORED IN THE RESERVOIR WITH NO OUTFLOW.

SPILLWAY CAPACITY

THE SPILLWAY CREST IS ONE FOOT BELOW THE TOP OF DAM. THE ESTIMATE CAPACITY IS $Q = CLH^{3/2}$, WHERE

$Q = 3.5 \times 5 \times 1^{3/2} = 17.5$ CFS.

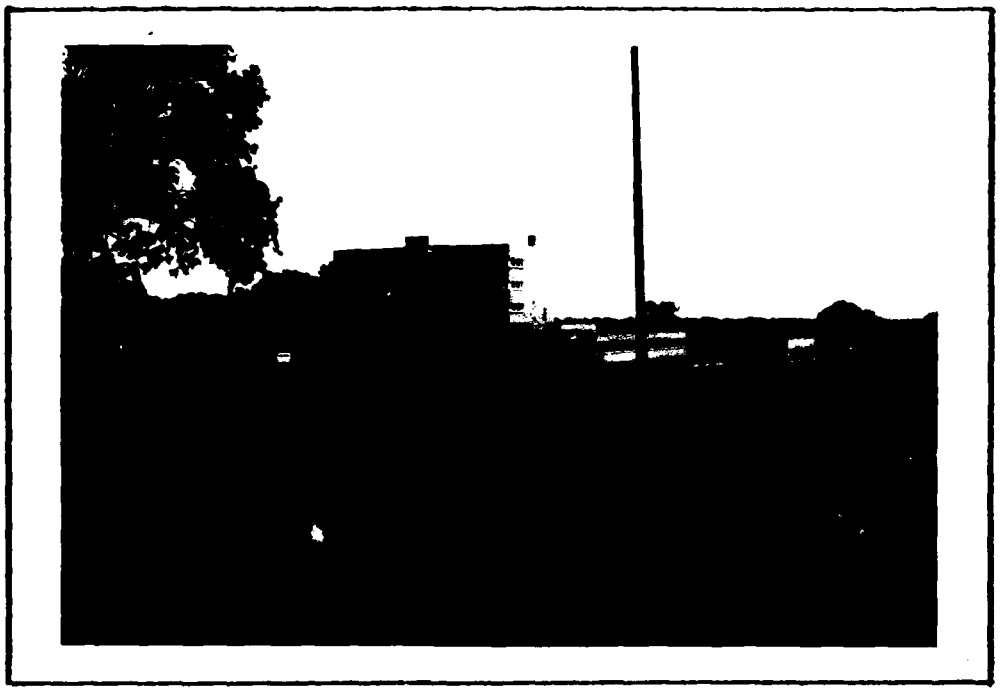
* THIS FACTOR ADJUSTS FOR THE PROBABLE MISALIGNMENT OF THE DRAINAGE BASIN AND STORM ISOHYETALS.

APPENDIX

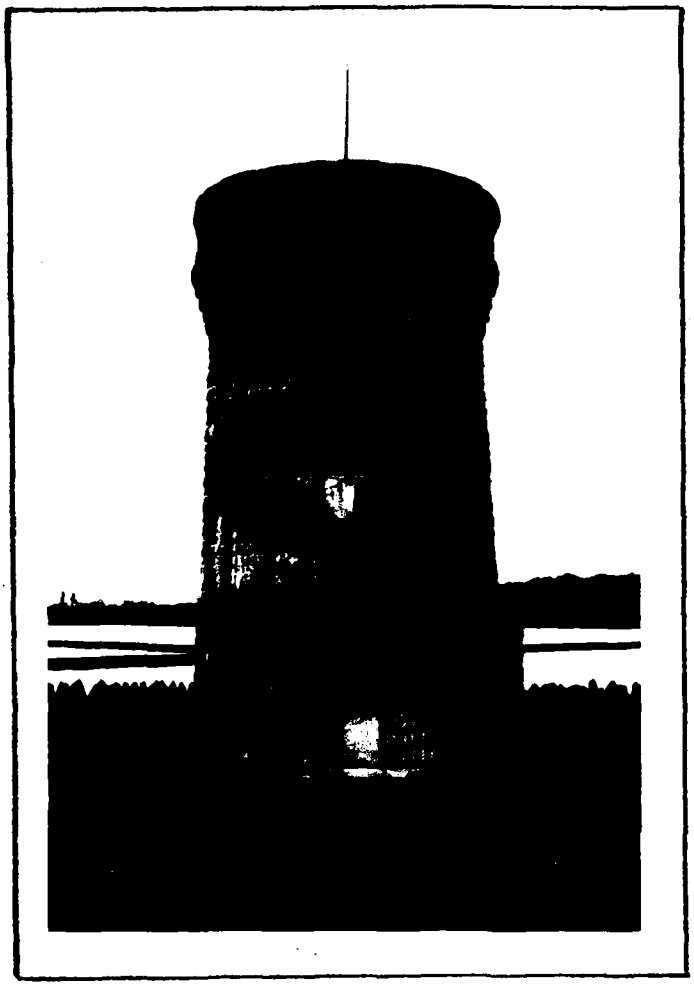
D

Photographs

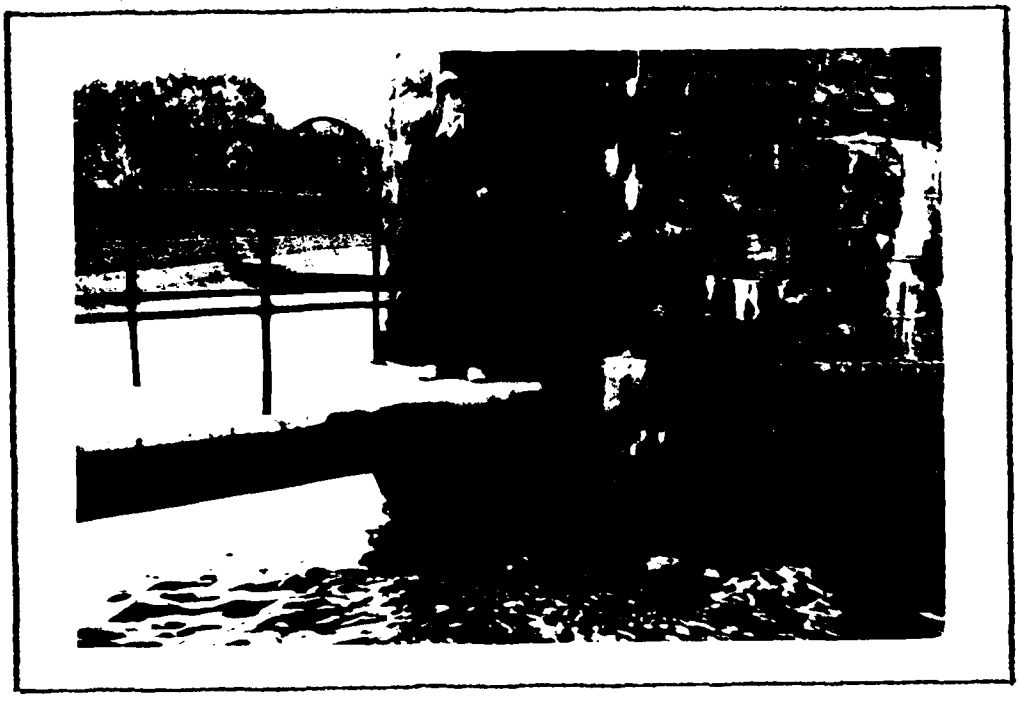
ROUTE 202 BORDERING THE
WEST SIDE OF THE EMBANKMENT
9-20-19



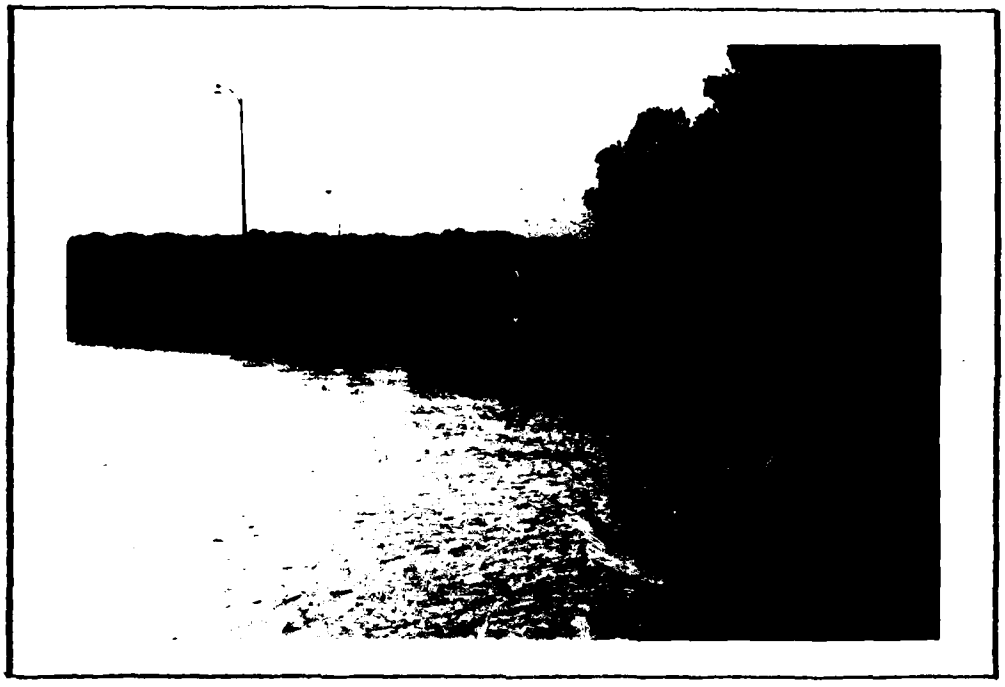
TREATMENT PLANT AS VIEWED
FROM NORTHWESTERN CORNER OF DAM
9-20-19



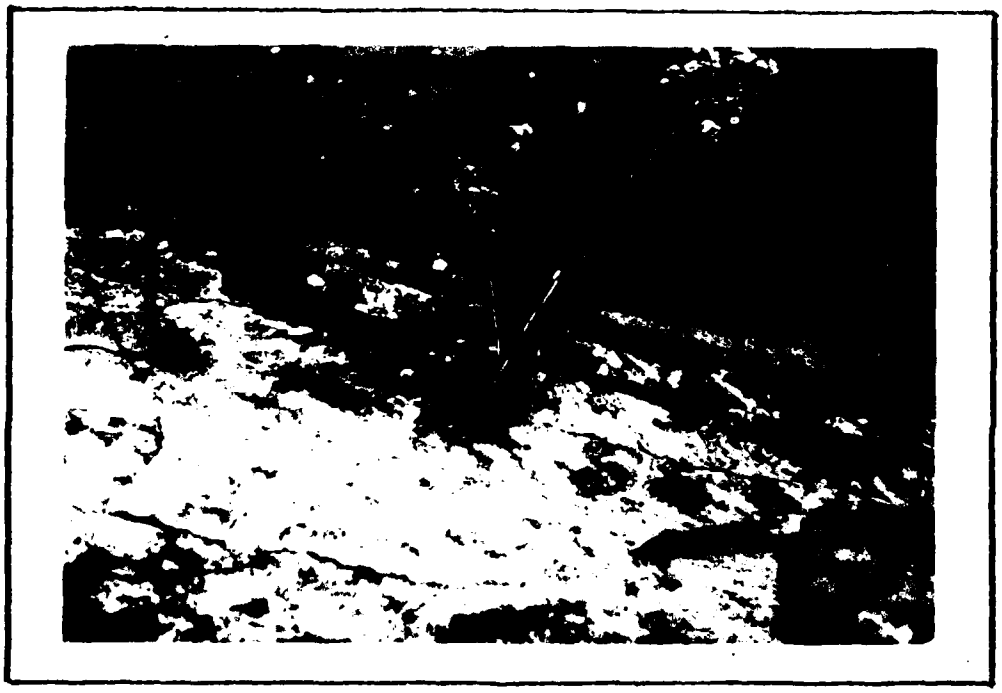
WEIR TOWER AND
ACCESS BRIDGE
9-20-79



BOX INLET SPILLWAY
BENEATH ACCESS BRIDGE 9-20-79

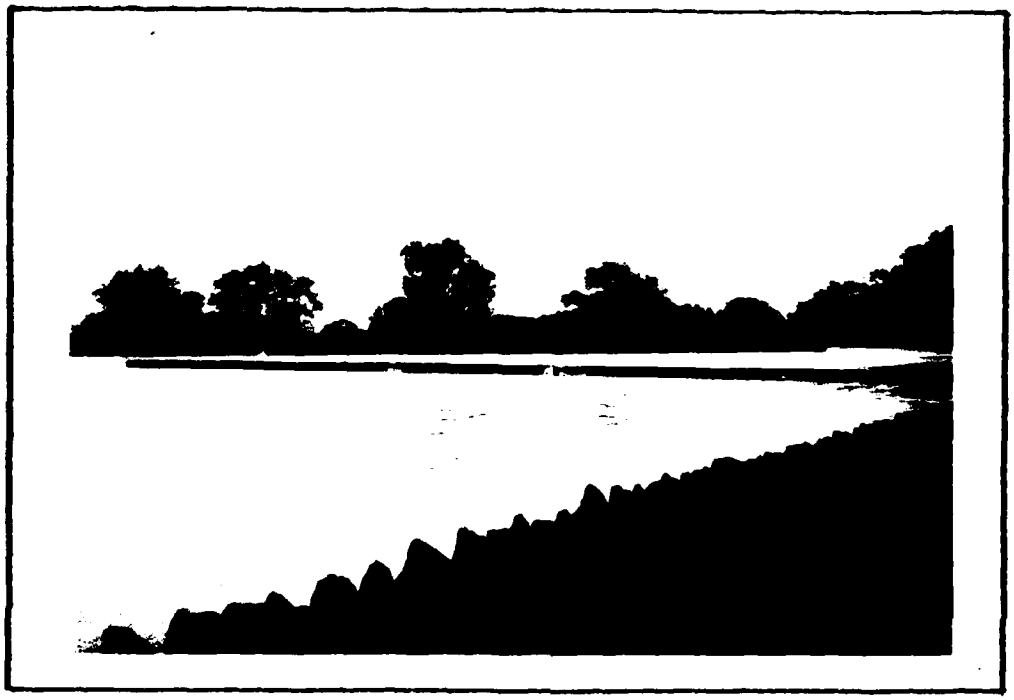


BUSHES GROWING ON EXPOSED PORTION OF INTERIOR SLOPE
9-20-79

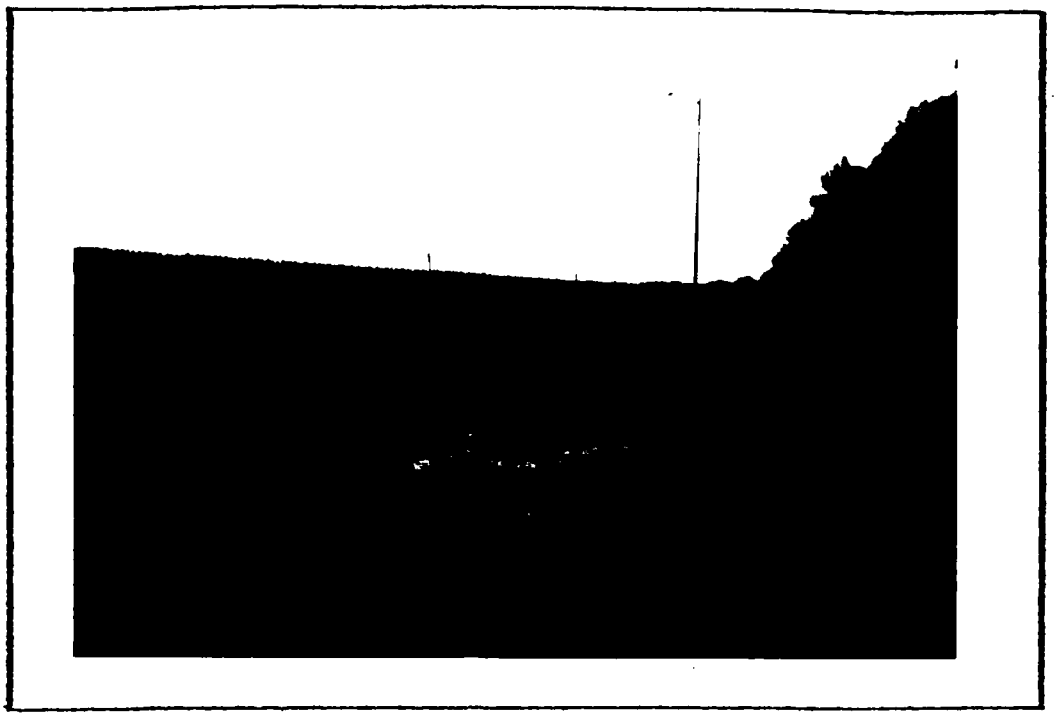


SPACES AND CRACKS IN PAVING BLOCKS
9-20-79

CLOSE-UP VIEW OF DETERIORATED BAFFLE WALL
9-20-79



OVERALL VIEW OF DETERIORATED BAFFLE WALL
9-20-79



SATURATED AREA NEAR TOE OF EMBANKMENT
9-20-79

GOLF COURSE IMMEDIATELY BELOW
SOUTHEASTERN SIDE OF DAM 9-20-79

APPENDIX

E

Drawings

TABLE OF CONTENTS

APPENDIX E

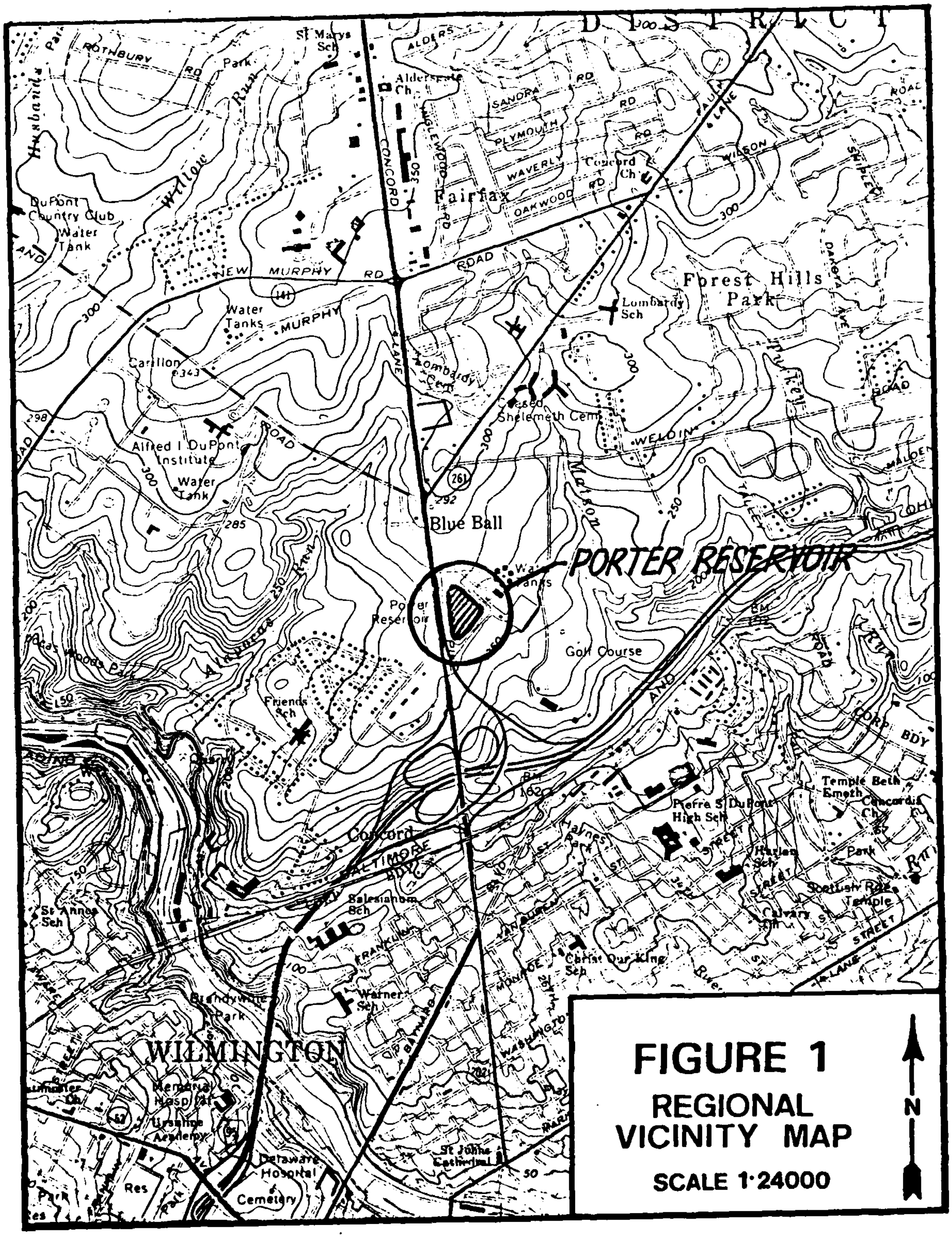
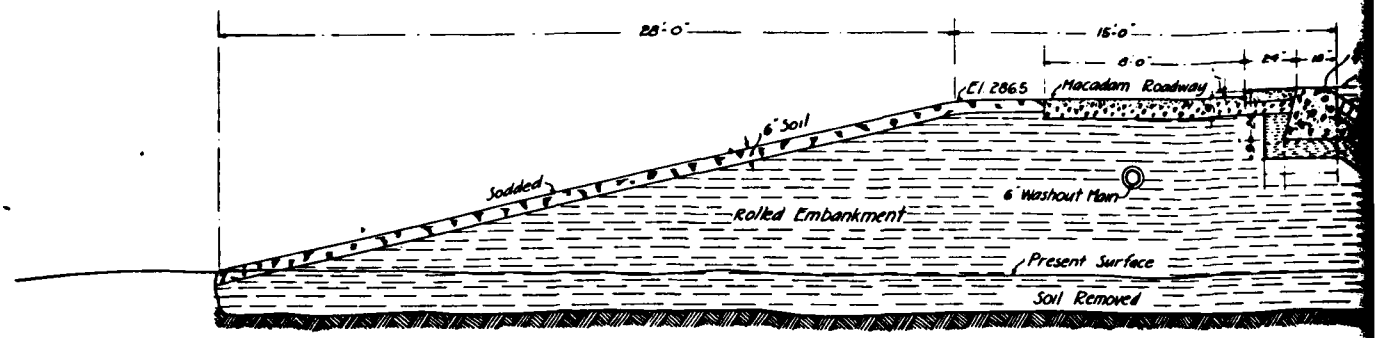


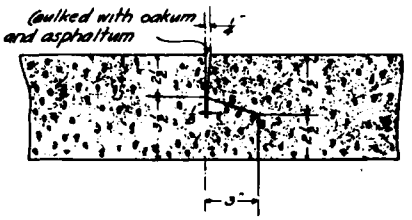
FIGURE 1

REGIONAL VICINITY MAP

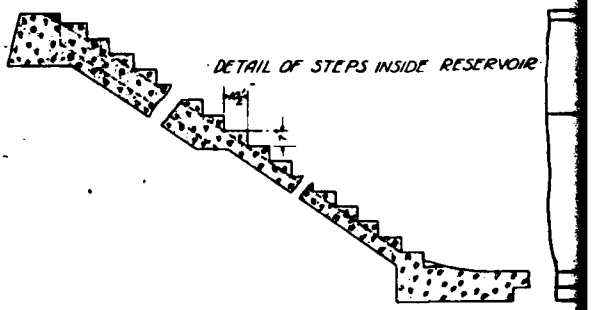
SCALE 1:24000

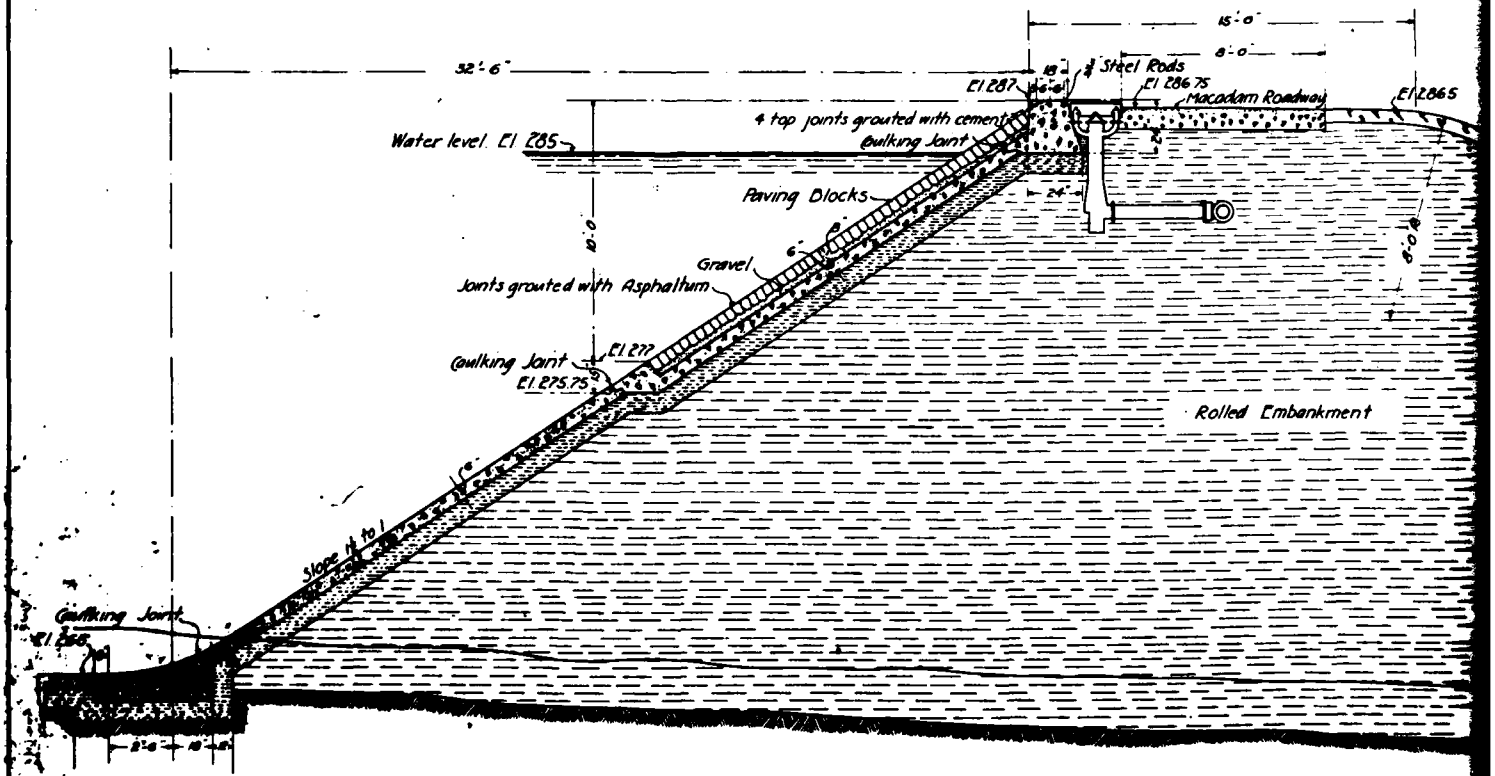
N



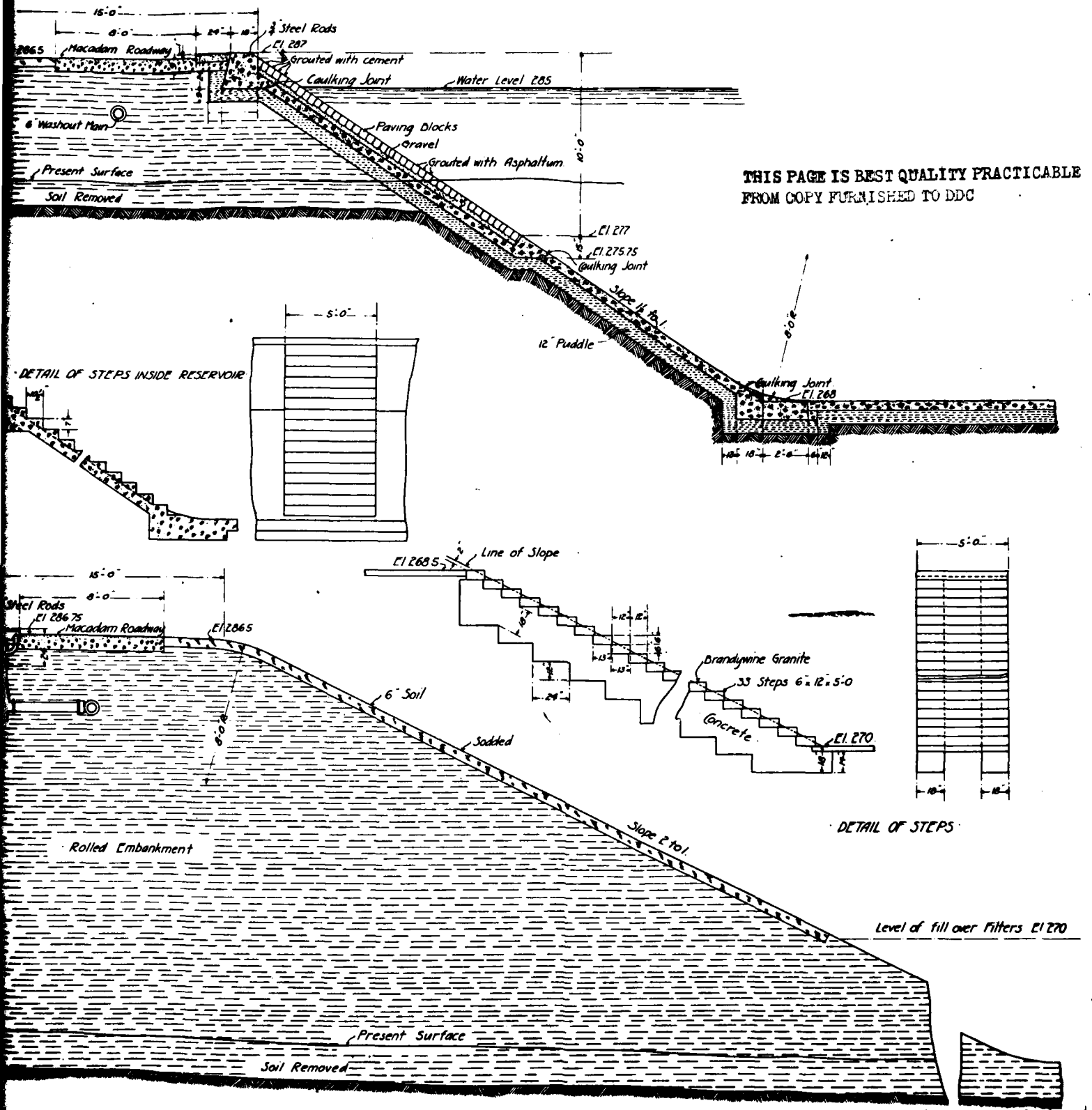


DETAIL OF CAULKING JOINT





EMBANKMENT SECTIONS



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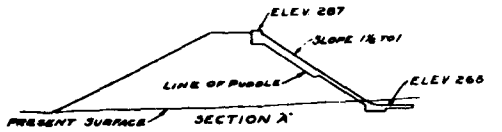
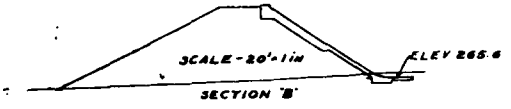
EMBANKMENT SECTIONS

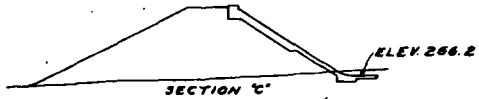
FIGURE 2

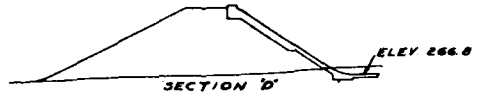
DRAWN BY E.R. HACK
CHECKED BY C.R.G.
APPROVED C.R.G.
DATE AUG. 5 1905.

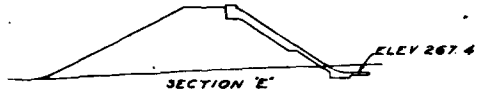
FILTRATION PLANT
AND
WATER SUPPLY SYSTEM
FOR
WILMINGTON, DEL.
1905
THEODORE A. LEISEN AND ASSOCIATES
EMBANKMENT SECTIONS

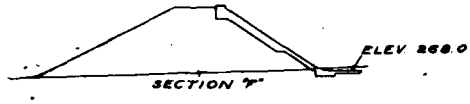

ELEV 287
SLOPE 1½ TO 1
LINE OF PUDDLE
ELEV 265
PRESENT SURFACE
SECTION 'A'


SCALE - 20' = 1 IN
ELEV 265.6
SECTION 'B'

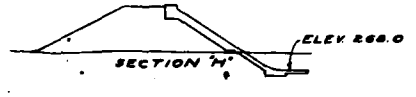

ELEV 266.2
SECTION 'C'


ELEV 266.8
SECTION 'D'

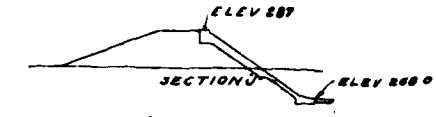

ELEV 267.4
SECTION 'E'


ELEV 268.0
SECTION 'F'


ELEV. 268.0
SECTION 'G'


ELEV. 268.0
SECTION 'H'


ELEV. 268.0
SECTION 'I'


ELEV 287
SECTION 'J'
ELEV 268.0

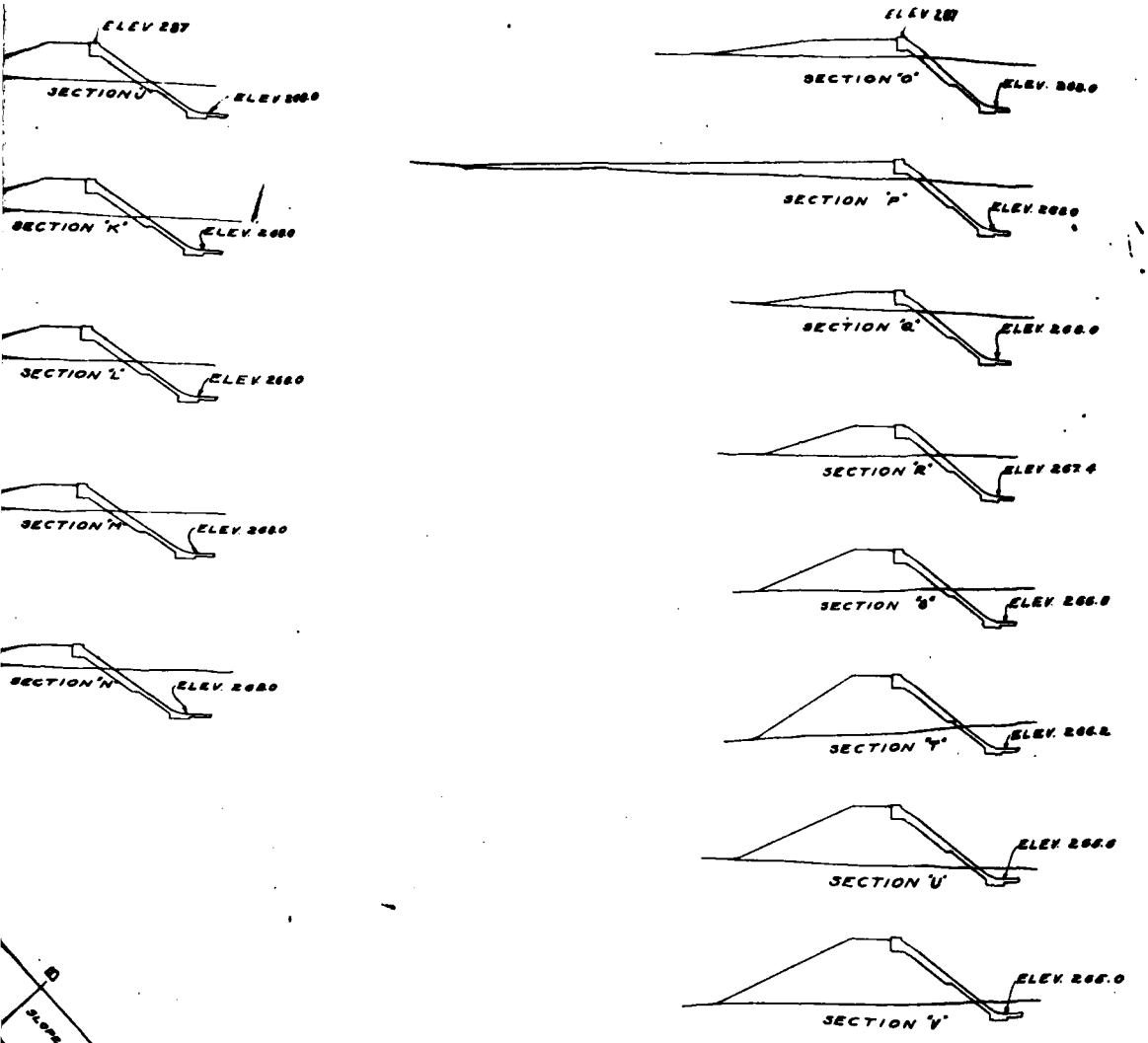

SECTION 'K'
ELEV 268.0


SECTION 'L'
ELEV 268.0


SECTION 'M'
ELEV 268.0


SECTION 'N'
ELEV 268.0

SLOPE 2 TO 1
ELEV 265
SLOPE 2 TO 1
SUMP - ELEV 264
265.0
266.0
267.0
SCALE - 50' - 1 IN
ELEV 268
ELEV 268



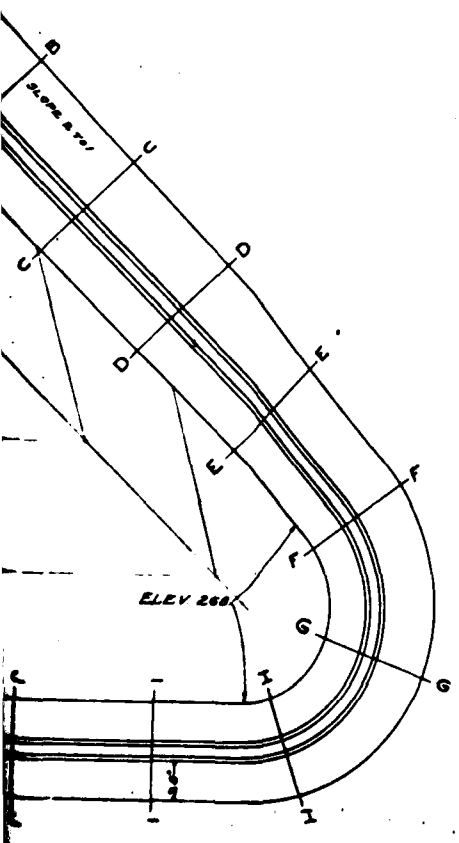
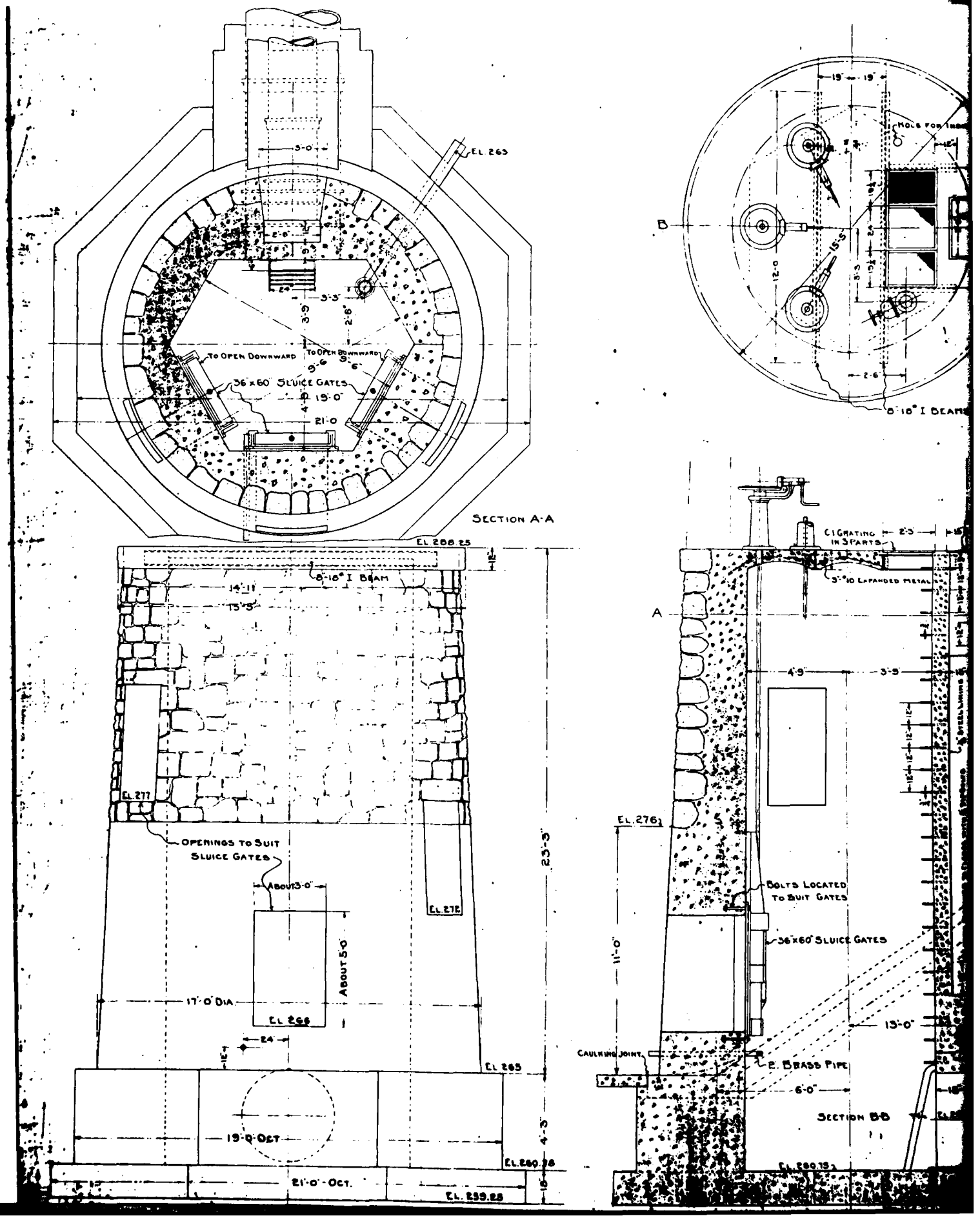


FIGURE 3

FILTRATION PLANT
AND
WATER SUPPLY SYSTEM
FOR
WILMINGTON, DEL.


EL 263
3-0
2-6
3-3
3-9
2-6
To Open Downward
To Open Downward
5-6
5-6
36 x 60 Sluice Gates
19-0
21-0
SECTION A-A
EL 288.25
8-18" I Beam
14-11
15-3
EL 277
Openings to Suit Sluice Gates
About 3-0
About 5-0
EL 272
23-3
17-0 Dia
EL 269
24
EL 265
19-0 Oct
4-3
EL 260.75
21-0 Oct.
EL 239.25
16
B
19
19
Holes for
12-0
15-5
2-6
8-18" I Beams
A
C.I. Grating in 3 Parts
3-10 Expanded Metal
4-9
3-9
Steel Lining
EL 276
Bolts Located to Suit Gates
36 x 60 Sluice Gates
11-0
15-0
Caulking Joint
2" Brass Pipe
6-0
Section B-B
EL 280.75

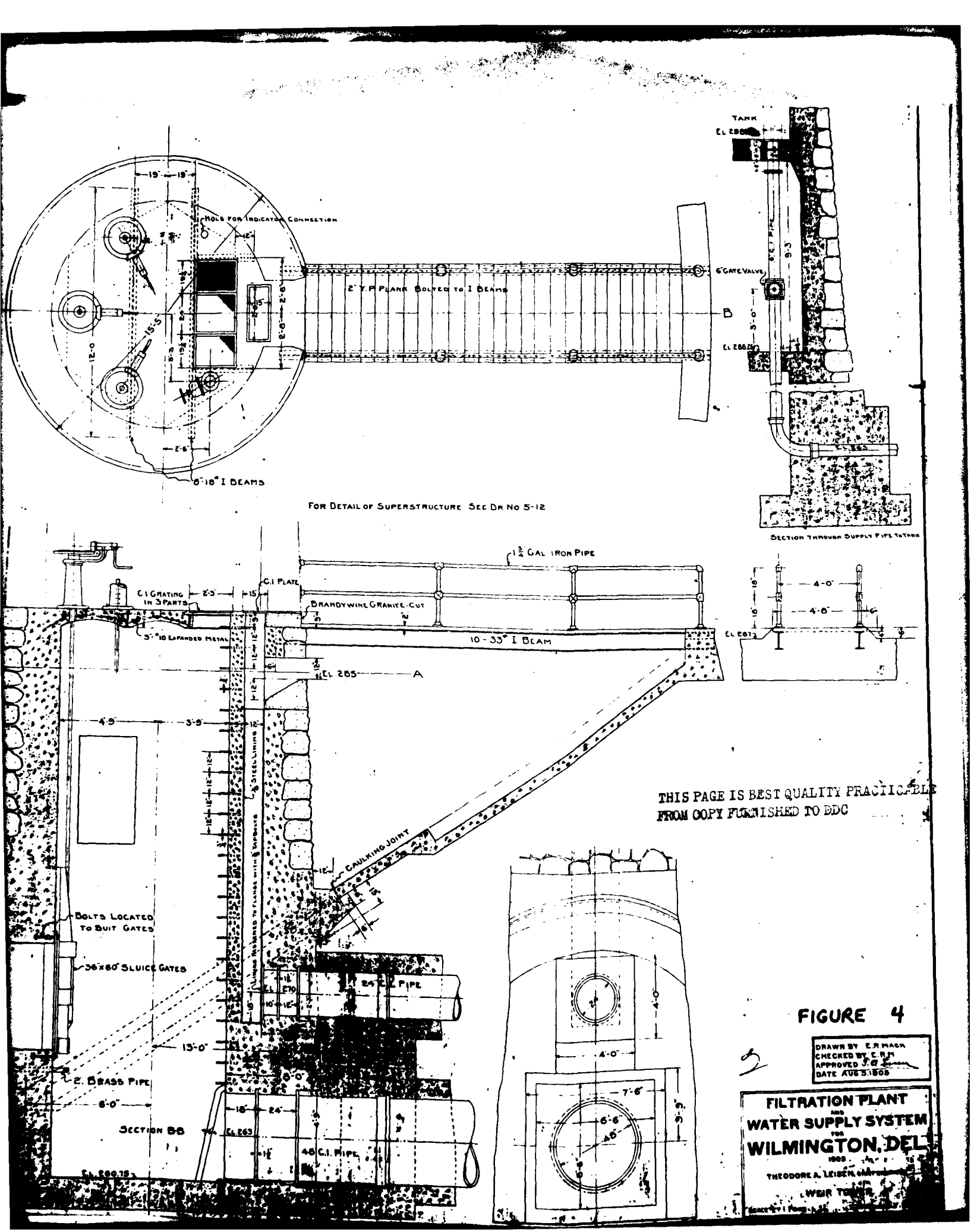

HOLE FOR INDICATOR CONNECTION
2" T. & G. PLANK BOLTED TO I BEAMS
8-18" I BEAMS
FOR DETAIL OF SUPERSTRUCTURE SEE DR NO 5-12
TANK
6" GATE VALVE
B
SECTION THROUGH SUPPLY PIPE TO TANK
1¾ GAL IRON PIPE
C.I. GRATING IN 3 PARTS
C.I. PLATE
BRANDYWINE GRANITE-CUT
3"-10 EXPANDED METAL
10-33" I BEAM
A
CAULKING JOINT
BOLTS LOCATED TO SUIT GATES
36"x60" SLUICE GATES
24" C.I. PIPE
12" BRASS PIPE
SECTION BB
48" C.I. PIPE
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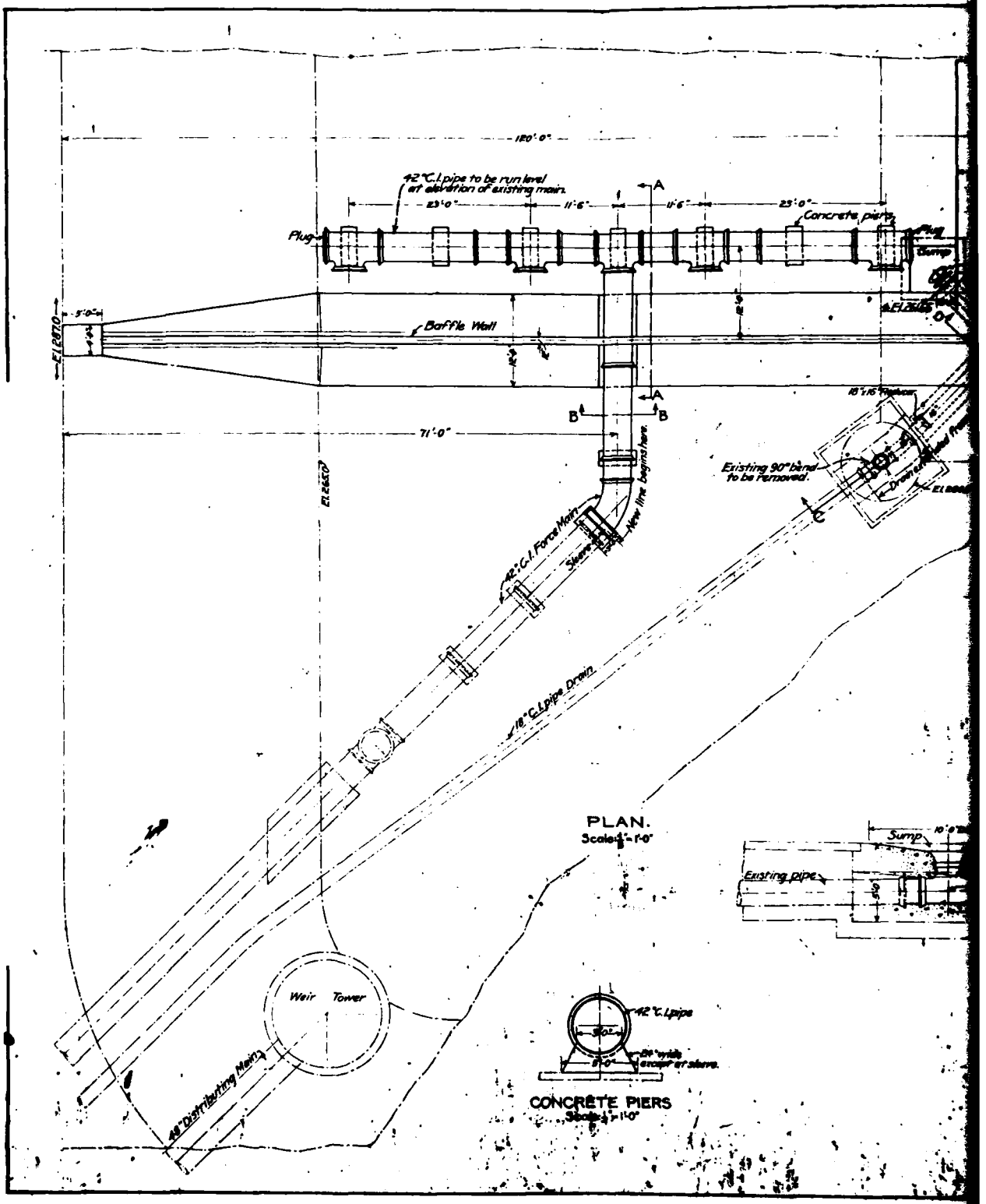
FIGURE 4
DRAWN BY E.R.MACH
CHECKED BY E.R.M.
APPROVED
DATE AUG 5 1908
FILTRATION PLANT
AND
WATER SUPPLY SYSTEM
FOR
WILMINGTON, DEL.
1908
THEODORE A. LEISEN, Engineer
J. WEIR TAYLOR, Consulting Engineer


120'-0"
42"C.I. pipe to be run level at elevation of existing main.
23'-0"
11'-6"
11'-6"
23'-0"
Concrete piers
Plug
Plug
Sump
EL 2870
5'-0"
Baffle Wall
A
A
B
B
71'-0"
EL 2850
New line begins here.
42"C.I. Force Main
Sleeve
Existing 90° bend to be removed.
18"C.I. pipe Drain
PLAN.
Scale 1/8" = 1'-0"
Sump
Existing pipe
Weir Tower
42"C.I. pipe
8'-0"
48"Distributing Main
CONCRETE PIERS
Scale 1/2" = 1'-0"

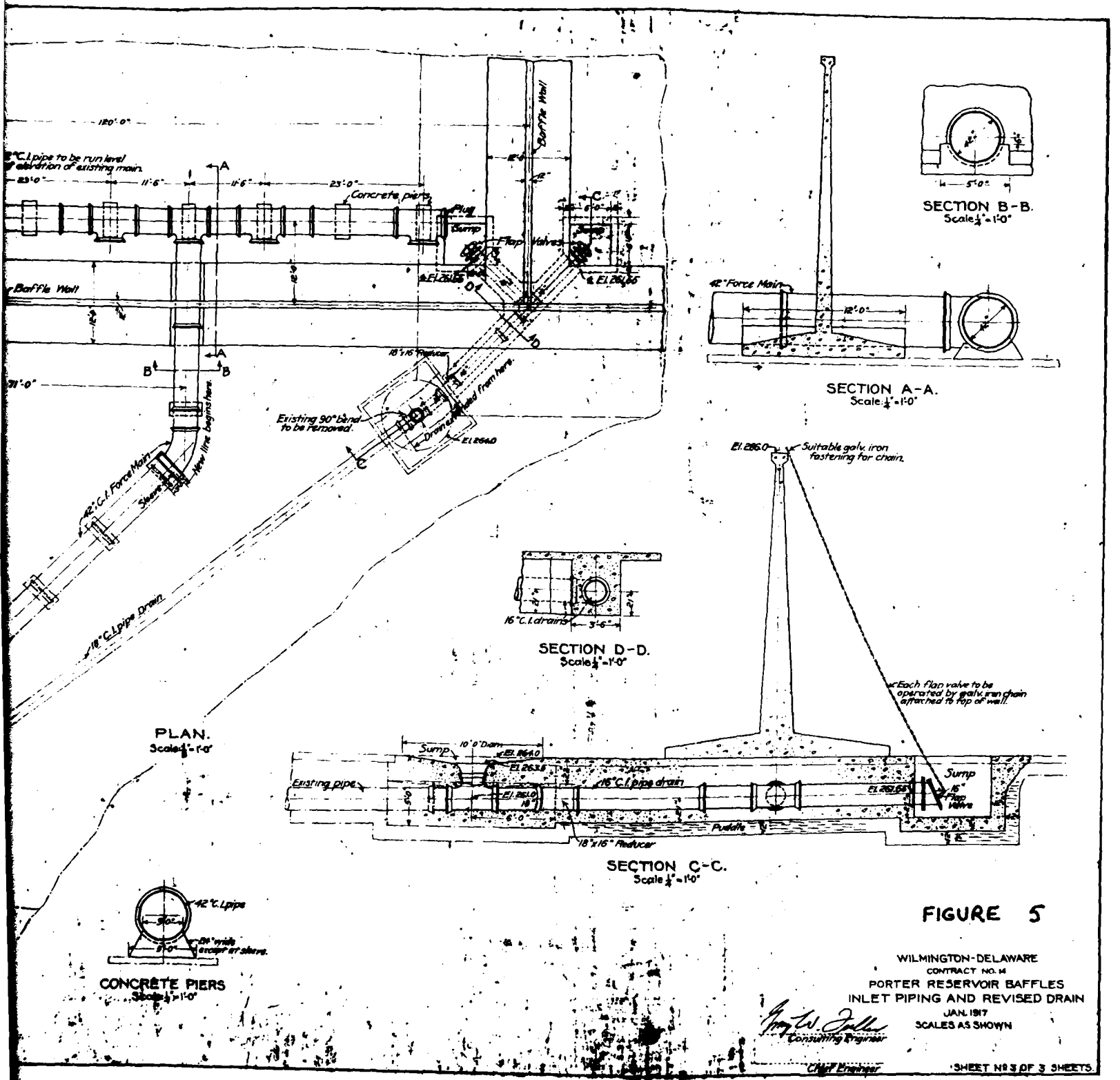


FIGURE 5

WILMINGTON-DELAWARE
CONTRACT NO. 14
PORTER RESERVOIR BAFFLES
INLET PIPING AND REVISED DRAIN
JAN. 1917
SCALES AS SHOWN

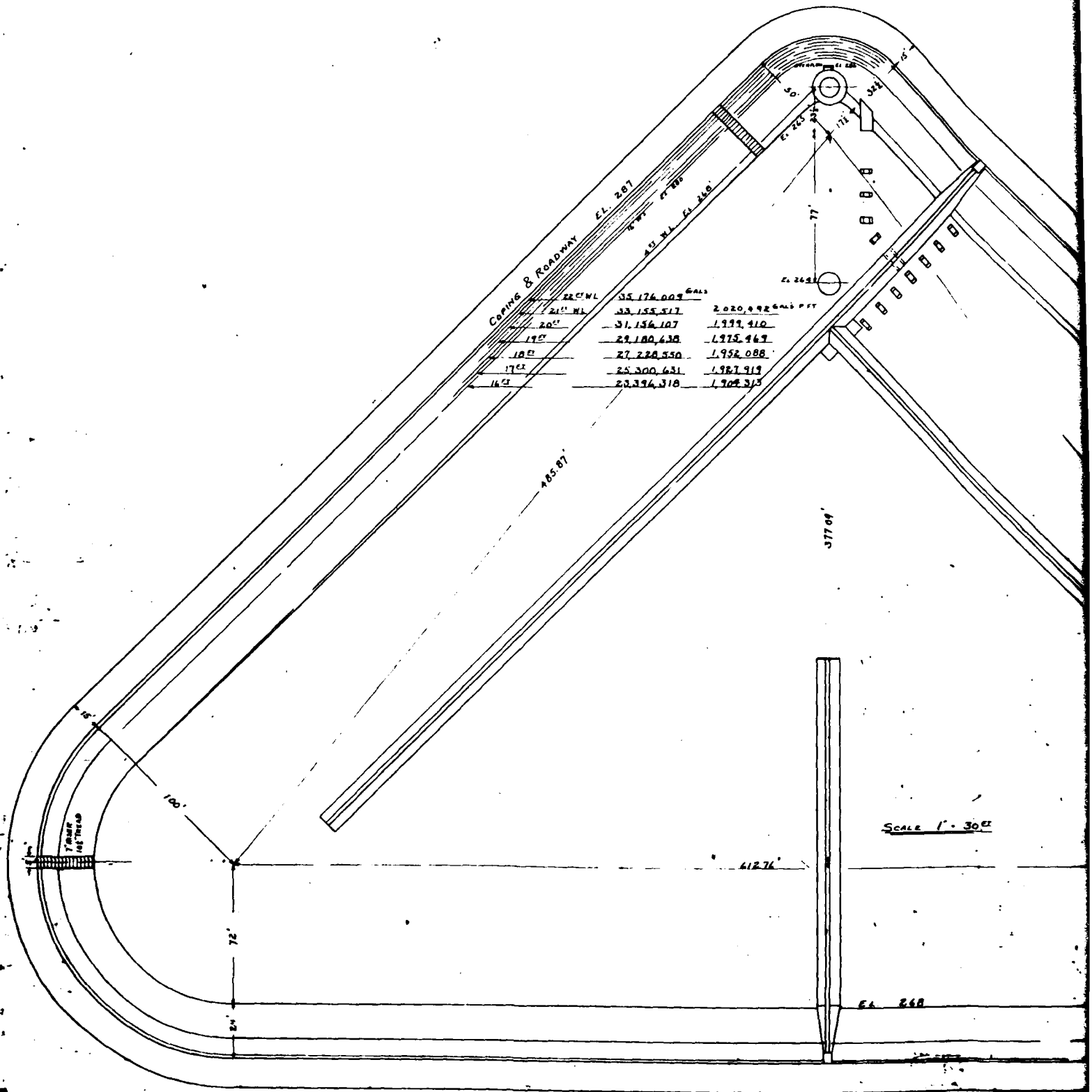
Consulting Engineer

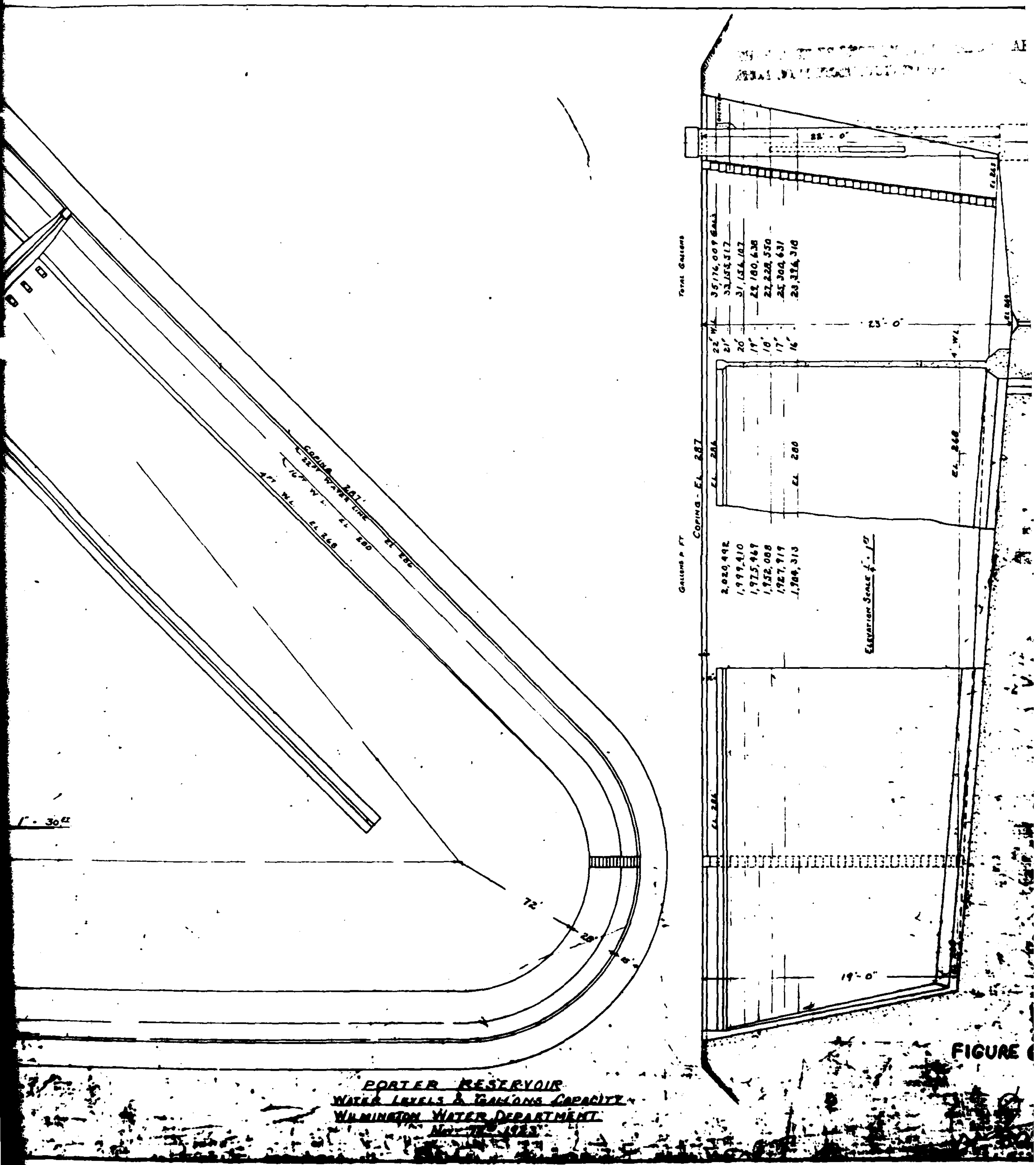
Chief Engineer

SHEET NO 3 OF 3 SHEETS

2

08-N


COPING & ROADWAY EL. 287
EL. 265
EL. 269
77'
72'
485.87'
377.09'
412.76'
100'
15'
72'
24'
EL. 268
SCALE 1" = 30'
THIS SIDE PARALLEL TO CONCORD TURNPIKE
22" WL 35,176,009 GALS
21" WL 33,155,517 2,020,492 GALS PER FT
20" 31,156,107 1,999,410
19" 29,180,638 1,975,469
18" 27,228,550 1,952,088
17" 25,300,631 1,927,919
16" 23,396,318 1,904,313


Coping 287'
22 FT Water Line
16 FT W.L. El 280
4 FT W.L. El 268
El 286
72'
28'
15'
1" = 30 FT
22' - 0"
23' - 0"
19' - 0"
Total Gallons
22' W.L. 35,176,009 Gals
21' 33,155,517
20' 31,156,107
19' 29,180,638
18' 27,228,550
17' 25,304,631
16' 23,396,310
Gallons per FT
2,020,492
1,999,410
1,975,469
1,952,088
1,927,919
1,904,313
Coping - El 287
El 286
El 280
El 268
4' W.L.
Elevation Scale 1/4" = 1 FT
PORTER RESERVOIR
WATER LEVELS & GALLONS CAPACITY
WILMINGTON WATER DEPARTMENT
Nov 1923

FIGURE

APPENDIX

F

Site Geology

SITE GEOLOGY

PORTER RESERVOIR DAM

Porter Reservoir Dam is located in the Lowlands Section of the Piedmont physiographic province. Bedrock at the site is the Paleozoic Wilmington Complex which is composed of banded gneiss with prominent amounts of gabbro, amphibolite and granite. These metamorphic and igneous rocks have differentially weathered in situ such that their character varies from a hard rock mass to a soil-like material.

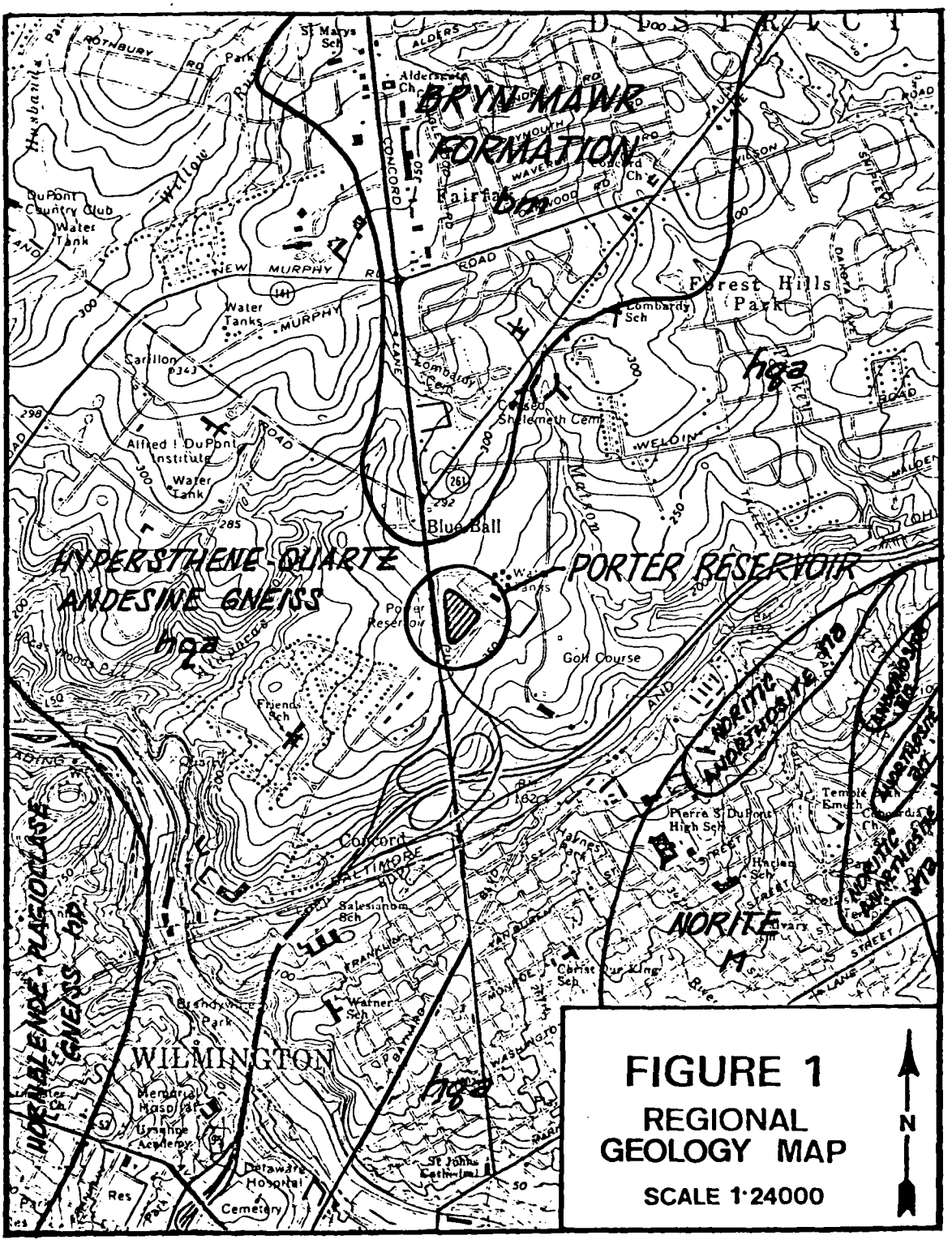


FIGURE 1

REGIONAL GEOLOGY MAP

SCALE 1·24000

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DE00013	2. GOVT ACCESSION NO.: AD-A085 933
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program **Porter** Reservoir, DE	5. TYPE OF REPORT & PERIOD COVERED: FINAL
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): John J. Williams, P.E.	8. CONTRACT OR GRANT NUMBER(s): DACW61-78-C-0052
9. PERFORMING ORGANIZATION NAME AND ADDRESS: O'Brien & Gere Engineers Inc / Suite 1760 J.F.K. Boulevard Phila. Pa. 19103	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE: December, 1979
	13. NUMBER OF PAGES: 35
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office):	15. SECURITY CLASS. (of this report): Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

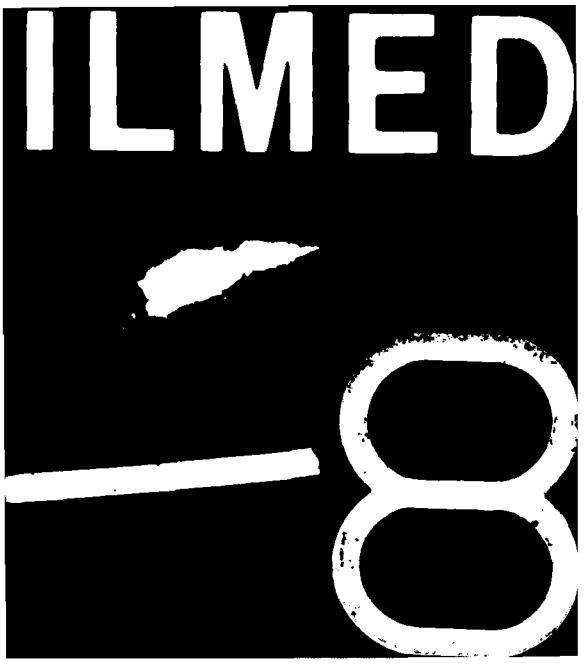
Dams
Visual inspection
Structural analysis
National Dam Safety Program
Safety
Porter Reservoir, DE.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)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